1.0 GROUNDWATER MONITORING & SAMPLING PROCEDURES

1.1 WATER LEVEL MEASUREMENT

Static groundwater levels were measured in sixty-one (61) monitoring wells manually using an electronic water level indicator instrument (i.e. Solinst) on September 5th, 2006. Additionally, each monitoring wells were gauged for total depth (TD) using the same water level indicator used for the depth to water measurements.

Water level measurements were taken from the top of the wellhead casing indicating the top of casing (TOC) elevation (feet above mean sea level [ft-msl]) determined by a State-Licensed Land Surveyor (surveyor). If there is no visible survey mark to take the measurement, the well was gauged from the north side of the top of casing and recorded on the Well Gauging Data Sheet (WGDS).

1.1.1 Instrument Calibration

Water level indicators were calibrated each sampling event. Calibration was performed by comparing the water level indicator measuring tape against a steel tape. The calibration dates, times, instrument identification, method, and result was recorded on the Instrument Calibration Sheet (ICS).

1.1.2 Instrument Decontamination

Equipment used in the gauging of groundwater monitoring wells, that were inserted into the well casing and static groundwater were decontaminated prior to and/or after each use at any well location.

The water level indicator was decontaminated between each well using one (1) non-phosphate wash, two (2) tap water rinses, followed by one (1) distilled-water rinse. The equipment was dried either using a clean paper towel or an electric-driven air-compressor or a hair dryer.

1.2 Field Procedures

Wells to be gauged were identified by personnel collecting measurements by comparing current WGDS's, site plans, individual well markings, and historical data tables. If there is no established mark on top of casing, the measurement was taken from the north side of the casing. Each measurement point description was logged in detail on the WGDS.

The depth to water measurements was taken three (3) times at a minimum to allow for the recording of a correct measurement with no variations. Measurements and any observations were recorded on the WGDS.

Each water level measurement was compared to the historical measurements or previous measurement obtained from the same well. If the current measurement is significantly different than the previous measurements or the water level changed to opposite direction of the other wells (i.e. all other wells showing increase in depth to water but the last well shows decrease) the following QC procedures were performed in the field:

- Verified the well identification and location.
- Verified that the instrument read accurate (checked calibration)
- Verified that the measurement was repeated several times (3 times minimum).
- Verified that there was no foreign material in the well affecting the tape length.
- Verified that there was no kink on the tape
- Recorded on the form the true reading and mention that these QC procedures were performed on the comments section of the field form

1.3 GROUNDWATER SAMPLE COLLECTION

A total of thirty-nine (39) wells (17 wells for semi-annual, 16 wells for WDR, 6 wells for quarterly) were sampled between September 6th and 13th, 2006 using a Grundfos pump, Horiba water tester with flow through cell and Solinst water level meter. WDR wells were sampled using low flow purging methods. Ferrous iron testing was performed in all semi-annual and quarterly wells using Hach DR/890 field instrument. Ferrous iron and hydrogen sulfide testing were performed in all WDR wells using Hach DR/890 field instrument.

1.3.1 Water Parameter Readings

Equipment was thoroughly decontaminated prior to lowering in to the well. Pump was set approximately 3 to 5 feet below the water table. Purging was performed at flow rates less than 2 gpm. Water quality parameters were measured at the start of well pumping and at minimum every ½ wet casing volume removed. The wells were purged a minimum of three wet casing volume or until the parameters stabilize to within 10%. The following water quality parameters were measured using Horiba® U22 water quality meter (U22) and flow through cell (FTC): pH, temperature (°C), electrical conductivity, turbidity, dissolved oxygen (DO), oxygen reduction potential (ORP). The following steps were performed when collecting water parameter readings.

- U22 was calibrated to specified calibration (manufactures calibration solution), and zero DO solution.
- Water quality parameters were collected at start of pumping and for every 1/2 wet casing volume for three (3) consecutive wet casing volumes until parameters stabilize to within 10%.
- Current water parameter measurements were compared with historical data.
- Once well purging was finished U22 and FTC were decontaminated.

1.3.2 Groundwater Monitoring Well Evacuation

The following procedures were used for groundwater monitoring well purging:

- Reviewed HSP
- Calibrated field equipment to proper specifications
- Followed sampling order strictly
- Collected all required Q/C samples
- Ensured generators and fuel driven equipment were placed down-wind from sample locations
- Measured and recorded depth to water (DTW) and TD
- Determined casing volume to be purged from well using one of the methods described

below.

2-inch diameter well:

(height of water column) x (.163) = volume of water column in gallons

4-inch diameter well:

(height of water column) x (.65) = volume of water column in gallons

6-inch diameter well:

(height of water column) x (1.47) = volume of water column in gallons

At least three (3) casing volumes were purged from each well. If three casing volumes cannot be obtained and the well goes dry with minimum practical pumping rate, then the well was allowed to re-charge to 80% of the static water level (water column height x 0.80 – TD) before collecting sample. If 80% recovery exceeds 2 hours, the well was sampled as soon as enough water accumulated to fill all sample containers.

The pump flow was gauged manually using a graduated measuring stick calibrated to 55 gallon drum or 5 gallon bucket. Total volume purged was measured with this graduated stick and recorded every ½ wet casing volume.

1.3.3 Ferrous Iron Parameter Readings

After the wells were purged a minimum of three wet casing volume or after the parameters stabilized to within 10%. The following water quality parameter was measured using a Hach DR890 Series Colorimeter: Fe2+ (Ferrous Iron). The following steps were performed when collecting parameter readings.

- DR890 was calibrated to specified calibration using manufacturers calibration method.
- Water quality parameter was collected following manufacturers standard parameter collection protocols, mixing sample with 1, 10 Phenanthroline powder pillow reagent according to Method 8146.
- The method has a 3 minute reaction time that was measured using an electronic watch and the Hach instrument clock.
- Results appear in the form of mg/L Fe2+.

1.3.4 Hydrogen Sulfide Parameter Readings

After the wells were purged a minimum of three wet casing volume or after the parameters stabilized to within 10%. The following water quality parameter was measured using a Hach DR890 Series Colorimeter: H2S (Hydrogen Sulfide). The following steps were performed when collecting parameter readings.

- DR890 was calibrated to specified calibration using manufacturers calibration method.
- Water quality parameter was collected following manufacturers standard parameter collection protocols, mixing sample with N, N-dimethyl-p-phenylenediamine oxalate according to Method 8131 to form methylene blue.

- The method has two reagents that must be mixed with the sample and has a five minute reaction time that was measured using both an electronic watch and the Hach instrument clock.
- Hydrogen sulfide and acid-soluble metal sulfides react with N, N-dimethyl-p-phenylenediamine oxalate to form methylene blue. The intensity of the blue color is proportional to the sulfide concentration.
- Results appear in the form of mg/L sulfide.

1.3.5 Sample Collection

Groundwater samples were collected in the appropriate laboratory sample containers from the discharge end of the pump or bailer. Pump flow was set at 0.2 gpm or less during collection to prevent aeration and turbulence of samples. Sample container labels were filled out at the well location and placed on containers immediately after samples are collected.

The samples were placed in a cooler in a manner to prevent breaking or cross-contamination during transport. Samples were placed in to plastic zip-lock bags to prevent the possibility of cross-contamination. The cooler was filled with ice and samples kept a desired temperature of 4 °C., pending transport to the project analytical laboratory (PAL).

1.4 DECONTAMINATION

Equipment used in the gauging and sampling of groundwater monitoring wells, that is inserted into the well casing and static groundwater was decontaminated prior to and/or after each well location. The equipment was decontaminated between each well using one (1) non-phosphate wash, two (2) tap water rinses, followed by one (1) distilled-water rinse. Water generated during decontamination activities was contained in 55-gallon drums and placed in a pre-designated area for disposal. Waste was inventoried daily on an IDW Inventory Record.

Once decontamination was completed existing latex gloves were removed and a new pair were used at the next well location.